

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (currently amended) A method for detecting an eye position from a face image including at least an eye area, the face image being taken under near infrared light, comprising the steps of:

performing brightness correction for part or the entire of the face image to increase the contrast between a sclera portion and an iris portion of the eye;

calculating brightness gradient vectors for the brightness-corrected face image; and

performing matching between a brightness gradient image generated using the calculated brightness gradient vectors and an eye template,

wherein the eye position is detected based on the results of the matching,

wherein the brightness correction step includes the steps of:

calculating a brightness gradient for each pixel in a part of the face image for brightness correction;

generating an expression for conversion for histogram equalization using ~~pixels in the part having a brightness gradient intensity falling within the top predetermined rate~~ some of pixels in the part, the some pixels being a top A percent of the pixels in the part ranked according to a brightness gradient intensity where A is a predetermined value; and

performing histogram equalization for all pixels in the part using the generated expression for conversion.

2. (cancelled)

3. (previously presented) The method of Claim 1, wherein a correlation between an image size and a filter size, capable of intensifying an edge of the iris portion against the sclera portion is previously calculated, and

the calculation of the brightness gradient in the brightness correction step is performed using a filter having a size determined to correspond to the size of the face image based on the calculated correlation.

4. (previously presented) The method of Claim 1, wherein a correlation between an image size and a filter size, capable of intensifying an edge of the iris portion against the sclera portion is previously calculated, and

the calculation of the brightness gradient in the brightness correction step is performed using a filter having a predetermined size and changing the size of the face image to correspond to the filter size based on the calculated correlation.

5. (original) The method of Claim 1, wherein the brightness correction step includes the steps of: calculating an average brightness for part or the entire of the face image; and

performing the brightness correction when the calculated average brightness is smaller than a predetermined value while performing no bright correction when it is equal to or greater than the predetermined value.

6. (original) The method of Claim 1, wherein the brightness correction step includes the steps of: splitting an area of the face image subjected to the brightness correction into a plurality of partial areas; and

performing the brightness correction for each of the partial areas.

7. (original) The method of Claim 6, wherein the splitting of the area includes splitting the area subjected to the brightness correction into right and left parts.

8. (original) The method of Claim 7, wherein the splitting of the area includes detecting the position of a nose from the area subjected to the brightness correction, and splitting the area subjected to the brightness correction into right and left parts with respect to the position of the nose.

9. (previously presented) The method of Claim 1,
wherein the eye template includes a plurality of points each having a brightness gradient vector, the points being placed on a curve corresponding to the boundary between an eyelid and an eyeball and on the periphery of an iris portion, and

the points placed on the periphery of the iris portion are arranged in n concentric circles (n is an integer equal to or more than 2).

10. (cancelled)

11. (previously presented) The method of Claim 1,

wherein in the matching, points on the brightness gradient image corresponding to pixels of the face image having a brightness value greater than a predetermined value are excluded from correlation value calculation for the matching.

12. (withdrawn) A method for detecting an eye position from a face image including at least an eye area, comprising the steps of:

(1) calculating a first matching score by performing matching between the face image or an image obtained by converting the face image and an eye template; and

(2) calculating a second matching score by performing matching between the face image or an image obtained by converting the face image and a pupil template,

wherein the eye position is detected based on the first and second matching scores.

13. (withdrawn) The method of Claim 12, further comprising the step of (3) modifying the first matching score by considering the second matching score, wherein the eye position is detected using the modified first matching score.

14. (withdrawn) The method of Claim 12, wherein the step (1) is performed for an image obtained by reducing the face image, and the step (2) is performed for the original face image.

15. (withdrawn) The method of Claim 14, wherein the step (1) includes the step of selecting a portion to be an eye position candidate based on the first matching score, and

the step (2) performs the matching using the pupil template only for a region of the selected eye position candidate corresponding to an iris portion of the eye template and surroundings of the region.

16. (currently amended) A device for detecting an eye position from a face image including at least an eye area, the face image being taken under near infrared light, comprising:

means for performing brightness correction for part or the entire of the face image to increase the contrast between a sclera portion and an iris portion of an eye;

means for calculating brightness gradient vectors from the brightness-corrected face image; and

means for performing matching between a brightness gradient image generated using the calculated brightness gradient vectors and an eye template,

wherein the eye position is detected based on the results of the matching,

wherein the brightness correction means performs the steps of:

calculating a brightness gradient for each pixel in a part of the face image for brightness correction;

generating an expression for conversion for histogram equalization using ~~pixels in the part having a brightness gradient intensity falling within the top predetermined rate~~ some of pixels in the part, the some pixels being a top A percent of the pixels in the part ranked according to a brightness gradient intensity where A is a predetermined vlaue; and performing histogram equalization for all pixels in the part using the generated expression for conversion.

17. (previously presented) The device of Claim 16,
wherein the eye template includes a plurality of points each having a brightness gradient vector, the points being placed on a curve corresponding to the boundary between an eyelid and an eyeball and on the periphery of an iris portion, and
the points placed on the periphery of the iris portion are arranged in n concentric circles (n is an integer equal to or more than 2).

18. (previously presented) The device of Claim 16,
wherein in the matching, points on the brightness gradient image corresponding to pixels of the face image having a brightness value greater than a predetermined value are excluded from correlation value calculation for the matching.

19. (withdrawn) A device for detecting an eye position from a face image including at least an eye area, comprising:

means for calculating a first matching score by performing matching between the face image or an image obtained by converting the face image and an eye template; and

means for calculating a second matching score by performing matching between the face image or an image obtained by converting the face image and a pupil template,

wherein the eye position is detected based on the first and second matching scores.